WORKING PAPER · DOCUMENT DE TRAVAIL

Canadian Transport Commission
Research Branch

Commission canadienne des transports
Direction de la recherche

The Cost of Trucking Grain in Western Canada

WP 30-85-11

Canada

COST OF TRUCKING GRAIN IN WESTERN CANADA

FREIGHT STUDIES DIRECTORATE
RESEARCH BRANCH
CANADIAN TRANSPORT COMMISSION
1985

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Printed in Canada

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June 1985

PREFACE

This document presents an overview of a study of truck operating costs on the Prairies. This study provided the necessary background data for the update of one major module of the Producer Haul and Elevator Receipts system, specifically, the model which estimates the trucking cost component of a farmer's out of pocket expenses for grain handling and transportation services. The PHAER information system itself has a certain unique aspect due to its capability to integrate farm production with trucking, elevation, and rail service cost elements into an analytical model that is based on actual deliveries.

A working paper is being published at this time as part of the continuing program of communication of Research Branch projects. It is intended for a broad audience and thus elaborate description of technical or methodological detail has been avoided where possible.

The results and views expressed in this paper are those of the authors, and are not necessarily those of the Government of Canada or the Canadian Transport Commission.

Research Branch publications may be requested from the Publications Division, CTC, Ottawa K1A 0N9. Any questions regarding this report should be addressed directly to the Agricultural Products Division.

R. Lake
Executive Director
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THE COST OF TRUCKING GRAIN

INTRODUCTION

Over the past 10 years the Research Branch of the Canadian Transport Commission has developed PHAER, the Producer Haul and Elevator Receipts information system, a multi-sectoral, multi-modal database and analytical model of the grain handling and transportation system in Western Canada. To update trucking cost data and to expand the trucking mode sector of the model, the Freight Studies Directorate contracted with Trimac Consulting Services Ltd. (Trimac) to perform the financial analysis of grain truck costing using a Trimac survey data base of information on actual operating expenses. The primary objective was to derive information about the typical (i.e. average) cost per work unit (tonne-kilometers) for operating existing trucking facilities where this "average operating cost" is the total of average costs associated with the actual movement of the truck, maintenance of the truck, and the costs of purchasing and financing the truck. The results were used to quantify the relationship between cost and grain volume, age of the vehicle, haul distance travelled, annual kilometers travelled and interest rates. Ideally, this will permit examination of policy options relating to railway and grain elevation rationalization, farm operating costs, and certain federal subsidy programs.

This document will present a summary of the consultant's methodology and results, provide conclusions derived by Freight Studies through analysis of the consultant's work, and indicate potential uses of this data and areas where further study may be beneficial.

CONSULTANT'S METHODOLOGY

Since 1972 Trimac Consulting Services Ltd. has produced a biennial study on the operating costs of trucks in Canada.[1] When this report was

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[1] Trimac Consulting Services Ltd.; Operating Costs of Trucks in Canada, 1982; Calgary, Alberta; Report prepared for the motor Carrier Branch, Surface Administration, Transport Canada.

prepared, the latest version of that study was completed in July 1982 and it formed the foundation upon which this Costs of Trucking Grain in Western Canada study (CTG) was developed. The CTG used the same data base, methodology, procedures and results (where appropriate) as the biennial study.

After consultation with vehicle supplier/manufacturers and the Research Branch, Trimac choose seven truck types to be analysed in the study. The vehicle types are based on payloads of 3, 5, 8, 10, 15, 25, and 40 ton. The 3, 5, 8 and 10 ton trucks represent configurations typical of vehicles that would be owned or leased by producers/farmers while the 25 and 40 ton vehicles represent typical grain handling commercial sized trucks available through single trip or seasonal contracts with commercial fleet owners. Here the size of the truck is taken to be the size of payload which is the registered gross vehicle weight (RGVW) minus the tare weight.

The study also included vehicle age as a variable since operating cost was expected to vary with vehicle age.

TRIP RELATED OR VARIABLE OPERATING COSTS

Surveys conducted by Trimac on actual operating costs of trucking in Canada provide a detailed breakdown of the expenditure components. Trimac Ltd. provided data on their 400 commercial-sized vehicles in operation in the Prairies and the 600 vehicles at Rentway Ltd. in Prairie operations. The cost figures from the above sources were then compared to data of other trucking companies who were clients of Trimac Consulting Services Ltd. Aggregation and averaging of the actual operating cost data provided estimates of the individual unit cost components for selected vehicle sizes.

The Freight Studies Directorate requested operating costs for a commercial vehicle in the 15 ton truck size range which had similar characteristics to the 8 and 10 ton producer-sized vehicles. It was

established later that the 15 ton truck chosen, as a commercial vehicle, is a rarely used configuration and the amount of actual operating data was limited. Therefore, the cost components for this vehicle size are estimates based more on Trimac's experience and knowledge, than actual data.

LABOR WAGE COST COMPONENT

Farm wages in Canada for the year 1982, obtained from Statistics Canada, were used to approximate the value of driver time for producer-sized vehicles. For commercial trucks, Trimac surveyed prevailing wage rates for drivers in the three Prairie provinces.

FUEL COSTS

Average fuel prices were determined by consulting with a major oil company. Fuel consumption levels for the different vehicle sizes were determined from the Trimac fleet operating data base for new vehicles.

MAINTENANCE COSTS

Repair costs for each vehicle size were estimated from Trimac in-house data on similar vehicles with average ages of two to three years.

OTHER COST COMPONENTS

Individual trip costs include the cleaning, loading and unloading of the truck on each trip. Estimates of the time involved in these activities combined with driver wage rates provides trip-related labour cost estimates for each truck size. Time estimates were based on Trimac's experience.

FIXED OVERHEAD OR ANNUAL COSTS

Vehicle ownership costs were based on an empirically validated exponential depreciation relationship and Trimac statistics for low mileage/long life vehicles and an assumed annual interest rate of 15 % on all equity.[2] To compute the component cost of these relationships, 1982 vehicle prices were developed in consultation with suppliers. In this context, it should be noted that "normal" (cost related) price levels were assumed rather than using 1982 prices which were often less than manufacturing costs and reflected current recessionary levels unsustainable by the truck/trailer manufacturing industry over the long term.

An annual cost component was attributed to depreciable items subject to damage, normal wear or loss - such as tarps, accessories, small tools and chains. Total annual cost also included provincial licensing and insurance.

Administration overhead and contribution to profit provisions for producer-sized trucks are assumed to be zero. In respect of insurance premiums for Saskatchewan and Manitoba government plans, most truck operators view their contributions as a tax. As insurance coverage in the government plan is considered by most prudent commercial operators to be inadequate, additional coverage is generally carried by the truck operator. For commercial trucks, insurance was assumed to be 3 % of overall costs. Administration overhead was 10 % of overall costs, the profit provision was 10 % of overall costs and interest on working capital was 4 % of overall costs (assuming 15 % interest rate).

PRODUCTIVITY ASSUMPTIONS

The productivity assumptions used in this study are as follows: average speed during the haul distance trips is assumed to be 56 kilometers

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2 Although we recognize that lending institutions are unlikely to finance 100 % of vehicle acquisition if the investor's pretax return on equity is equated to interest levels, annual interest/return charges may be equated to interest rate times equity value.

per hour (35 mph). The annual kilometers travelled by the 3, 5, 8 and 10 ton producer-sized vehicles is a sum of the calculated grain-related kilometers of the haul and an assumed distance for non-grain-related vehicle use. Non-grain-related kilometers is the annual distance travelled by the truck for purposes other than transporting grain from the central storage facility at the farm to the elevator. Non-grain-related kilometers may include transporting grain from fields to central storage facility, moving furniture, gravel or fertilizer, etc. The percentages of non-grain kilometers travelled per year to total kilometers travelled per year by truck size were obtained from a 1971 farm trucker survey. The percentages for this study were based on the 1971 survey but were adjusted to take into consideration significant elevator consolidation and increased productivity for larger size trucks since 1971. For 15, 25, and 40 ton commercial-sized vehicles the assumed annual kilometers are based on actual operating experience of the surveyed firms. Given these last two points, it is emphasized the reader must note the assumptions at the bottom of the tables herein. As a final point of clarification, the haul distance per trip relates only to that portion of the trip from a central storage facility on the farm to the grain elevator; thus the entire trip involves twice the one-way haul distance.

MODEL SPECIFICATION

Accounting rather than regression techniques were used to analyse the sample data and derive the following equation. The average cost per tonne-kilometer of operating a truck in the Prairies is:

$$\text{Cost} = C_1 + C_3 + C_8 + t\,(C_2 + C_4 + C_{10}) + \frac{C_5}{d} + \frac{(C_6 + C_7.i)e^{-.23t} + C_9}{a}$$

where 't' is the age of the vehicle in years.

'd' is the one-way haul distance from farm to selected elevator, in kilometers.

'i' is the interest rate (%).

'a' is the annual distance travelled for all trips in kilometers.

and C_i's are average unit cost components for each truck type and province. These are defined as follows:

C_1 is the basic fuel cost component of operating either a gasoline or diesel powered truck. (cents/tonne km)

C_2 is the additional energy consumption cost component which varies with the age of the vehicle. (cents/tonne km)

C_3 is the wages cost element for the driver of the vehicle and those labor costs involved with maintaining the vehicle. (cents/tonne km)

C_4 is the labour cost component relating to maintenance/repair costs which vary with the age of the vehicle. (cents/tonne km)

C_5 is the labour cost associated with the individual trip, for cleaning, loading and unloading time. (cents/tonne)

C_6 is the cost component for expenses directly relating to vehicle ownership or purchase costs. (cents/tonne)

C_7 is the debt service cost component for interest on loans or an opportunity cost estimate, both based on the depreciated book value of the vehicle. (cents/tonne)

C_8 is the cost of repairs component related to parts which have prices that are not age sensitive such as lubricants, etc. (cents/tonne km)

C_9 is the annual operating cost for all other overhead items such as insurance, licences, etc. (cents/tonne)

C_{10} is the maintenance/repair cost associated with parts prices which vary with the age of the vehicle. (cents/tonne/km)

TRIMAC SURVEY RESULTS

The actual Trimac report contained 75 tables, a sample of the results obtained are contained in the Appendix 1. Testing of Trimac's cost model resulted in the computation of numerous average cost values, a sample of which appears in Table 1. These values are based upon prairie average constants (C_i's) in the model.

Trimac prepared tables which include a section on the impact of assuming 10 % of trips have some backhaul load on which to defray costs. Put most simply, the average cost decreases by the percentage given to backhaul. It is assumed, especially with the commercial-sized trucks, that costs charged to clients will decrease due to the total cost of the one-way trip being spread over more revenue-producing kilometers.

Table 1 illustrates the change in the average cost per work unit with different haul distance and truck size, based upon typical operating

Table 1
AVERAGE COST OF WORK UNIT
(cents/tonne/kilometer)

Distance Haul (One-Way)	Truck Size Producer Owned Trucks				Truck Size Commercial Trucks		
km	3T	5T	8T	10T	15T	25T	40T
2.0	81.46	52.34	21.41	24.97	40.323	32.340	25.208
4.0	56.71	35.25	20.86	16.56	23.490	18.287	14.256
15.0	36.58	21.56	12.87	10.29	11.145	8.154	6.225
20.0	34.08	19.94	12.05	9.68	10.023	7.224	5.495
25.0	32.32	18.82	11.51	9.29	9.350	6.666	5.057
30.0	30.95	17.98	11.13	9.02	8.901	6.294	4.765
40.0	28.91	16.75	10.59	8.65	8.340	5.829	4.400
60.0	26.19	15.17	9.92	8.22	7.779	5.364	4.035
80.0	24.38	14.17	9.49	7.94	7.498	5.131	3.852
100.0	23.05	13.45	9.17	7.73	7.330	4.991	3.743
160.0	20.56	12.16	8.55	7.31	7.077	4.782	3.579
240.0	18.80	11.27	8.09	6.96	6.937	4.666	3.487
Assumptions:							
Total Annual Km	*	*	*	*	80,000	80,000	80,000
Total Annual Haul	100T	300T	500T	500T	-	-	-
Average Load/Trip	3T	5T	8T	10T	15T	25T	40T
Total Trips	33.33	60.0	62.5	50.0	-	-	-

Notes:

1. * Total Annual Km = $\frac{\text{Total Annual Haul}}{\text{Average Load/Trip}}$ X Distance Hauled X 2 - Non-Grain Miles (given).

2. Load capacity for grain excludes tare weight.

3. Prairie averages used for constants and the vehicles are 5 years old.

characteristics for the individual truck sizes. The total annual haul and total annual km (kilometers) figure varies by truck size because a larger-sized truck will require more tonnes of produce to be carried, i.e. higher annual utilization, in order to be economical to operate. The assumed minimum value for total annual kilometers for the commercial size trucks is 80,000 kilometers. This value is based upon utilization rates for other commercial truck operations, consideration of the seasonality of the transport of grain by truck, and consideration of the operations of grain trucking in Western Canada. The average cost figures in Table 1 were calculated from the model by fixing the age of the vehicle at 5 years and assuming an interest rate of 15 %.

Table 2 illustrates total annual trucking costs for a certain truck size, given a fixed total annual haul, over the common range for haul distance. The total annual haul assumption is based on the 1981 average total annual haul of 156 tonnes for the Prairie farmer. Note that the typical commercial vehicle would have in actuality a total annual haul much greater than the 156 tonnes shown in the table, but the 156 figure is used to illustrate the comparable total costs relative to the costs incurred by the average producer using his own vehicle.

The set of graphs which follow Table 2 illustrate the different average cost curves achievable given changes in three of the independent variables contained within the average cost function. The legend provided in the upper right hand corner of each graph provides an explanation of the different variable combinations used for each average cost curve. As the graphs depict, the major differences in the average cost values for producer-sized trucks, at any given haul distance, occur because of the age of the vehicle. Relatively small differences in the average cost values occur for changes in interest rates and for total annual haul. It is interesting to note that the average cost curves for 5 and 8 ton vehicles intersect for a change in the age of the vehicle from 5 to 15 years. The newer vehicles are apparently more expensive to operate than older vehicles over the shorter haul distances and less expensive over the longer haul distances.

Table 2
TOTAL ANNUAL TRUCKING COSTS
($)

Distance Haul (One-Way)	Truck Size Producer Owned Trucks				Truck Size Commercial Trucks		
km	3T	5T	8T	10T	15T	25T	40T
2.0	253.25	163.77	98.12	77.97	125.81	100.90	78.65
10.0	619.32	390.16	227.60	179.87	208.88	156.23	119.89
15.0	822.51	524.63	307.48	243.36	260.79	190.80	145.66
20.0	1011.19	654.26	386.88	306.38	312.72	225.39	171.44
25.0	1188.72	779.61	465.66	369.33	364.65	259.97	197.22
30.0	1356.73	901.37	543.35	431.96	416.57	294.56	223.00
40.0	1672.94	1135.06	697.63	555.98	520.42	363.73	274.56
60.0	2248.27	1569.67	999.65	802.15	728.11	502.07	377.68
80.0	2778.05	1973.09	1292.93	1044.58	935.75	640.35	480.73
100.0	3280.68	2349.36	1580.28	1283.88	1143.48	778.60	583.91
160.0	4707.46	3407.04	2403.65	1981.82	1766.42	1193.59	893.32
240.0	6525.79	4698.72	3444.48	2987.71	2597.21	1746.95	1305.53
Assumptions:							
Total Annual Haul	156T	156T	156T	156T	156T	156T	156T
Average Load/Trip	3T	5T	8T	10T	15T	25T	40T
Total Trips	52.0	31.2	19.5	15.6	10.4	6.24	3.9

Notes:

1. Average Cost Figures for commercial trucks were obtained from Table 1. Average Cost Figures for producer owned trucks were calculated especially for this table and were not obtained from any other table in this paper.

2. Total Cost for one-way haul distance for grain miles only.

The graphs of average cost per work unit values for commercial trucks show very small differences between the curves, implying that the average cost values are relatively insensitive for the indicated range of changes in the independent variables.

ANALYTIC RESULTS

Cost components which were divided by annual kilometers represent costs related to annual utilization while the other cost components included in the model represented the actual costs paid out by the owner of the vehicle for each trip depending upon haul distance. If one excludes annual costs, other interesting factors appear. Operating costs were determined by dropping all the cost components in the model which were divided by annual kilometers. Table 3 provides estimates of direct, trip dependent operating costs per work unit for the different truck sizes. The purpose of this table is to illustrate what the farmer perceives his actual costs to be in operating a truck and how this perception may affect his decision to operate his own vehicle or buy commercial haul service. For the commercial trucks, the operating cost values provide an indication of what tariff must be charged to cover only variable costs of the individual trip.

Further results of analysis by the Research Branch are contained in Table 4. These are the estimated elasticities of the average cost per unit of workload with respect to certain variables within the derived cost equation. Not all of the elasticities could be calculated due to the complexity of the average cost function specified by Trimac. The variables considered of primary importance were energy costs, wage costs, truck purchase prices, total annual utilization in kilometers and interest rates.

The elasticity of the cost function with respect to any variable indicates how sensitive the cost function is to a 1.00 % change in the value of the variables. On the basis of the relative elasticities, the cost of trucking one work unit will increase most significantly when wage costs are

Table 3
OPERATING COST OF WORK UNIT
(excludes annual cost components)
($)

Distance Haul (One-Way)	Producer Owned Trucks				Commercial Trucks		
km	3T	5T	8T	10T	15T	25T	40T
2.0	194.53	132.63	85.99	69.33	122.96	98.06	76.41
4.0	237.81	160.49	106.52	86.30	140.90	109.08	84.49
15.0	475.72	314.03	219.49	179.71	239.38	169.65	128.93
20.0	583.75	383.76	270.82	222.14	284.23	197.18	149.14
25.0	691.86	453.57	322.14	264.42	329.16	224.64	169.26
30.0	799.81	523.22	373.46	307.01	373.93	252.25	189.54
40.0	1016.50	662.69	476.11	391.87	463.63	307.01	320.26
60.0	1448.93	941.62	681.41	561.60	643.03	417.46	310.75
80.0	1880.74	1220.54	886.08	731.33	822.43	526.66	391.87
100.0	2313.48	1499.16	1092.00	900.12	1001.52	636.48	472.68
160.0	3611.71	2336.26	1707.26	1410.24	1540.03	968.45	713.86
240.0	5342.69	3451.97	2527.20	2089.15	2253.89	1407.74	1037.09
Assumptions:							
Total Annual Haul	156T	156T	156T	156T	156T	156T	156T

Table 4

ELASTICITY OF AVERAGE COSTS BY TYPE OF TRUCK

ELASTICITY OF AVERAGE COSTS WITH RESPECT TO ENERGY COSTS

	Truck Size						
Haul Distance	3 T	5 T	8 T	10 T	15 T	25 T	40 T
10	0.10	0.12	0.19	0.16	0.13	0.12	0.11
25	0.12	0.15	0.23	0.20	0.17	0.17	0.16
100	0.17	0.21	0.29	0.24	0.22	0.21	0.21

ELASTICITY OF AVERAGE COSTS WITH RESPECT TO WAGE COSTS

10	0.40	0.44	0.47	0.49	0.67	0.66	0.66
25	0.33	0.36	0.37	0.39	0.54	0.52	0.51
100	0.33	0.35	0.33	0.34	0.43	0.38	0.37

ELASTICITY OF AVERAGE COSTS WITH RESPECT TO TRUCK PURCHASE PRICES

10	0.30	0.26	0.22	0.23	0.14	0.14	0.14
25	0.34	0.30	0.26	0.27	0.19	0.20	0.20
100	0.33	0.29	0.26	0.29	0.24	0.25	0.26

ELASTICITY OF AVERAGE COSTS WITH RESPECT TO ANNUAL KILOMETERS

10		-0.13	-0.17	-0.17			
25		-0.18	-0.24	-0.25			
100		-0.22	-0.31	-0.32			

ELASTICITY OF AVERAGE COSTS WITH RESPECT TO INTEREST RATES

10	0.14	0.12	0.08	0.08	0.04	0.05	0.05
25	0.15	0.13	0.09	0.09	0.06	0.08	0.07
100	0.12	0.08	0.08	0.08	0.07	0.10	0.10

increased. Increases in truck purchase prices, especially for the smaller-sized trucks, also have a considerable impact. Increases in energy costs do not have a significant impact and increases in interest rates have almost no effect, except for smaller-sized trucks, upon increases in the average cost of trucking. As one expects, only increases in annual kilometers travelled will result in decreases in the average unit cost of trucking. Implicit in all the above is the assumption that the trucks are loaded to capacity for all trips travelled.

Comparisons of the operating characteristics of the different size trucks are captured in Tables 5 and 6. Table 5 shows the haul distance per trip at which the average cost of the larger truck becomes less than that of the smaller truck. For a workload equal to or greater than that stated in the assumptions at the bottom of the table, the 3 and 5 ton trucks should always be replaced with larger vehicles irrespective of haul distance per trip. In general, the 40 ton configuration should be the size of commercial truck chosen to haul grain irrespective of the haul distance, based upon the load/utilization assumptions within the table.

Using Prairie average operating characteristics and the 3 ton truck as a basis for comparison, Table 6 illustrates how much further the haul distance per round trip can be increased by using a larger vehicle without a farmer incurring additional costs. Note all vehicles replacing the 3 ton truck are assumed to be 5 years old as well. The replacement vehicle is assumed to be available to the farmer without the need for the farmer to purchase the replacement vehicle. Preliminary data suggests there is a substantial commercial fleet available to serve farmers. The table shows the advantage of larger size vehicles over smaller vehicles given that a choice is possible. If any farmer has access to the different size, producer owned trucks or can contract with an available commercial trucker, and has knowledge of distances to different elevator delivery points from his farm, these results may assist in planning and minimizing his cost of delivering grain - especially during situations where there are blockages at his local

Table 5

DISTANCE TRADEOFFS

For vehicles of capacity shown, the larger vehicle will be less expensive to operate on an average cost per ton basis if the one-way haul distance exceeds the value shown in the table.

Vehicle Substitution Options

This truck size (in tons)	5	8	10	15	25	40	8	10	15	25	40
replaces this truck size	3	3	3	3	3	3	5	5	5	5	5
Beyond a haul (in km) of:	0	0	0	0	0	0	0	0	0	0	0
Assumed total annual distance travelled (km):	4853	4853	4853	4853	4853	4853	7396	7396	7396	7396	7396
Assumed total annual haul (tons):	100	100	100	100	100	100	300	300	300	300	300

Note: The tradeoff is based on the larger vehicle travelling the same annual total distance and carrying the same annual total produce of the smaller vehicle. The age of the vehicles is 5 years and the interest rate is 15%.

Table 5
(continued)
DISTANCE TRADEOFFS

For vehicles of capacity shown in the heading, the larger vehicle will be less expensive to operate on an average cost basis if the one-way haul distance exceeds the value shown in the table.

Vehicle Substitution Options

This truck size (in tons)	10	15	25	40	15	25	40	25	40	40
replaces this truck size	8	8	8	8	10	10	10	15	15	25
Beyond a haul (in km) of:	0	73	6	0	*	12	3	0	0	0
Assumed total annual distance travelled (km):	15,700	24,663	16,350	15,700	-	25,250	24,300	80,000	80,000	80,000
Assumed total annual haul (tons):	500	500	500	500	500	500	500	-	-	-

Note: The tradeoff is based on the larger vehicle travelling the same annual total distance and carrying the same annual total produce of the smaller vehicle. The age of the vehicles is 5 years and the interest rate is 15%.

* 15T always more costly than 10T based on the assumed load/utilization stated, therefore a 15T will never replace a 10T truck.

Table 6

TRADEOFF OF TOTAL TRUCKING COSTS

For a typical farmer having a 1980/81 annual production of 156 tons (5062 bushels) and an average haul distance of 21.8 km, the haul distance can be increased to that shown in the table depending upon the size of the private or commercial truck chosen without a change in the total cost of transporting the grain from the farmgate to the elevator.

Vehicle Haul Capacity

	3T	5T	8T	10T	15T	25T	40T
Haul Distance (km)	21.8	37	64	83	94	141	196

Note:

1. The base is a 3 ton vehicle, 5 years old, with a haul distance of 21.8 km, and an annual haul of 156 tons and prairie average operating costs, and all replacement vehicles are 5 years old and have an annual haul of 156 tonnes.

2. For commercial trucks, the assumed annual kilometers driven is 80,000.

elevators and extra haul distance is required. Note that haul distance values shown in Table 6 are based on assumed load/utilization factors stated at the bottom of the table.

RESEARCH BRANCH APPLICATIONS FOR THE TRIMAC MODEL

The most immediate application of this study is to incorporate the results in the PHAER (Producer Haul and Elevator Receip') information system. In combination with knowledge of farm and elevator locations, the distance between the two and haul volumes, this trucking cost simulation model will provide the Research Branch with estimates of the trucking costs incurred by the specific farms and, subsequently, the additional trucking costs to be incurred if any part of the grain transportation and handling system is restructured in a manner which affects trucking distances or farmer's net haul costs.

Further, the Trimac model provides the Research Branch with trucking cost optimization information. This can be used to find optional sizes of trucks for given loads and distances, the opportunity for substitution economically of commercial trucks for producer-sized trucks, and perhaps to analyse the economic life of a truck of a certain size (i.e. at what age, interest rate and utilization level should a truck be replaced by a new truck.) The model gives the Research Branch a basis from which to investigate the benefits of future truck designs or different configurations and compare the operating costs of these new type of trucks to those presently used.

Appendix I

ANALYSIS OF GRAIN TRUCKING COSTS IN PRODUCER OWNED TRUCKS
October 1982 Levels

UNIT SIZE/TYPE: 3 TON BODY STRAIGHT TRUCK

ANNUAL GRAIN QUANTITY: 100

AGE OF VEHICLE: 5YR

NO BACKHAUL			HAUL DISTANCE (KM)	10 P.C. BACKHAUL		
ALBERTA	SASKATCHEWAN	MANITOBA		ALBERTA	SASKATCHEWAN	MANITOBA
40.42	41.30	40.68	10	36.75	37.55	36.98
33.75	34.43	34.06	20	30.68	31.30	30.97
30.67	31.24	30.96	30	27.88	28.40	28.15
28.66	29.15	28.92	40	26.06	26.50	26.29
24.24	24.53	24.36	80	22.04	22.30	22.14
20.54	20.65	20.50	160	18.67	18.77	18.64

By Trimac Consulting Services Ltd. on behalf of the Canadian Transport Commission.

ANALYSIS OF GRAIN TRUCKING COSTS IN PRODUCER OWNED TRUCKS
October 1982 Levels

UNIT SIZE/TYPE: 5 TON BODY STRAIGHT TRUCK

ANNUAL GRAIN QUANTITY: 300

AGE OF VEHICLE: 5YR

NO BACKHAUL			HAUL DISTANCE (KM)	10 P.C. BACKHAUL		
ALBERTA	SASKATCHEWAN	MANITOBA		ALBERTA	SASKATCHEWAN	MANITOBA
24.26	24.62	24.25	10	22.05	22.38	22.05
19.84	20.08	19.90	20	18.04	18.26	18.09
17.90	18.09	17.95	30	16.27	16.44	16.32
16.68	16.83	16.72	40	15.17	15.30	15.20
14.15	14.21	14.13	80	12.87	12.92	12.85
12.19	12.18	12.11	160	11.08	11.07	11.01

By Trimac Consulting Services Ltd. on behalf of the Canadian Transport Commission.

ANALYSIS OF GRAIN TRUCKING COSTS IN PRODUCER OWNED TRUCKS
October 1982 Levels

UNIT SIZE/TYPE: 8 TON BODY STRAIGHT TRUCK

ANNUAL GRAIN QUANTITY: 500

AGE OF VEHICLE: 5YR

NO BACKHAUL			HAUL DISTANCE (KM)	10 P.C. BACKHAUL		
ALBERTA	SASKATCHEWAN	MANITOBA		ALBERTA	SASKATCHEWAN	MANITOBA
14.36	14.53	14.29	10	13.06	13.21	12.99
12.01	12.12	12.00	20	10.92	11.02	10.91
11.10	11.18	11.10	30	10.09	10.17	10.09
10.56	10.63	10.57	40	9.60	9.66	9.61
9.48	9.51	9.47	80	8.61	8.64	8.61
8.56	8.56	8.54	160	7.79	7.78	7.76

By Trimac Consulting Services Ltd. on behalf of the Canadian Transport Commission.

ANALYSIS OF GRAIN TRUCKING COSTS IN PRODUCER OWNED TRUCKS
October 1982 Levels

UNIT SIZE/TYPE: 10 TON BODY STRAIGHT TRUCK

ANNUAL GRAIN QUANTITY: 500

AGE OF VEHICLE: 5YR

NO BACKHAUL			HAUL DISTANCE (KM)	10 P.C. BACKHAUL		
ALBERTA	SASKATCHEWAN	MANITOBA		ALBERTA	SASKATCHEWAN	MANITOBA
11.58	11.47	11.31	10	10.53	10.43	10.28
9.80	9.65	9.58	20	8.91	8.77	8.71
9.15	8.98	8.94	30	8.31	8.16	8.13
8.78	8.60	8.58	40	7.98	7.82	7.80
8.07	7.87	7.87	80	7.34	7.16	7.16
7.45	7.23	7.25	160	6.78	6.58	6.59

By Trimac Consulting Services Ltd. on behalf of the Canadian Transport Commission.

ANALYSIS OF GRAIN TRUCKING COSTS IN CUSTOM/COMMERCIAL TRUCKS
October 1982 Levels

UNIT SIZE/TYPE: 15 TON BODY STRAIGHT TRUCK

ANNUAL KILOMETERS: 40,000

AGE OF VEHICLE: 5YR

NO BACKHAUL			HAUL DISTANCE (KM)	10 P.C. BACKHAUL		
ALBERTA	SASKATCHEWAN	MANITOBA		ALBERTA	SASKATCHEWAN	MANITOBA
13.79	14.67	14.51	10	12.54	13.34	13.19
10.41	11.27	11.20	20	9.47	10.25	10.18
9.29	10.14	10.09	30	8.44	9.21	9.18
8.72	9.57	9.54	40	7.93	8.70	8.68
7.88	8.72	8.71	80	7.16	7.93	7.92
7.45	8.29	8.30	160	6.78	7.54	7.55
7.31	8.15	8.16	240	6.65	7.41	7.42

By Trimac Consulting Services Ltd. on behalf of the Canadian Transport Commission.

ANALYSIS OF GRAIN TRUCKING COSTS IN CUSTOM/COMMERCIAL TRUCKS
October 1982 Levels

UNIT SIZE/TYPE: 25 TON SEMI TRAILER TRUCK

ANNUAL KILOMETERS: 40,000

AGE OF VEHICLE: 5YR

NO BACKHAUL			HAUL DISTANCE (KM)	10 P.C. BACKHAUL		
ALBERTA	SASKATCHEWAN	MANITOBA		ALBERTA	SASKATCHEWAN	MANITOBA
10.92	11.07	10.78	10	9.93	10.06	9.80
7.99	8.30	8.11	20	7.26	7.54	7.38
7.01	7.37	7.23	30	6.38	6.70	6.57
6.53	6.91	6.78	40	5.93	6.28	6.17
5.79	6.22	6.12	80	5.27	5.65	5.56
5.43	5.87	5.79	160	4.93	5.34	5.26
5.31	5.76	5.68	240	4.82	5.23	5.16

By Trimac Consulting Services Ltd. on behalf of the Canadian Transport Commission.

ANALYSIS OF GRAIN TRUCKING COSTS IN CUSTOM/COMMERCIAL TRUCKS
October 1982 Levels

UNIT SIZE/TYPE: 40 TON TRAIN CONFIGURATION

ANNUAL KILOMETERS: 40,000

AGE OF VEHICLE: 5YR

NO BACKHAUL			HAUL DISTANCE (KM)	10 P.C. BACKHAUL		
ALBERTA	SASKATCHEWAN	MANITOBA		ALBERTA	SASKATCHEWAN	MANITOBA
8.82	8.42	7.97	10	8.01	7.66	7.25
6.38	6.28	5.97	20	5.80	5.71	5.43
5.57	5.57	5.30	30	5.07	5.07	4.82
5.17	5.22	4.97	40	4.70	4.74	4.51
4.56	4.68	4.46	80	4.14	4.26	4.06
4.25	4.41	4.21	160	3.87	4.01	3.83
4.15	4.32	4.13	240	3.77	3.93	3.75

By Trimac Consulting Services Ltd. on behalf of the Canadian Transport Commission.

Appendix II

Glossary of Terms

Total Annual Haul: is the assumed amount of grain produce a typical farmer will ship from his farm to elevators over a single year.

Total Annual Kilometers: is the assumed amount of kilometers a typical farmer or commercial driver will travel in a single year. For the farmer, the total is the sum of grain and non-grain miles; its calculation is shown in Note 1 of Table 1. For the commercial truck, the total annual kilometers are an assumed value, and represent the annual utilization of the vehicle.

Distance Haul: is the distance from a central storage facility on the farm to the grain elevator.

Total Trips: is a calculated value arrived at by dividing the total annual haul by the average load per trip or capacity of the truck.

Producer-sized Vehicles: are trucks of 3, 5, 8 or 10 ton size. These are the typical size for trucks which would

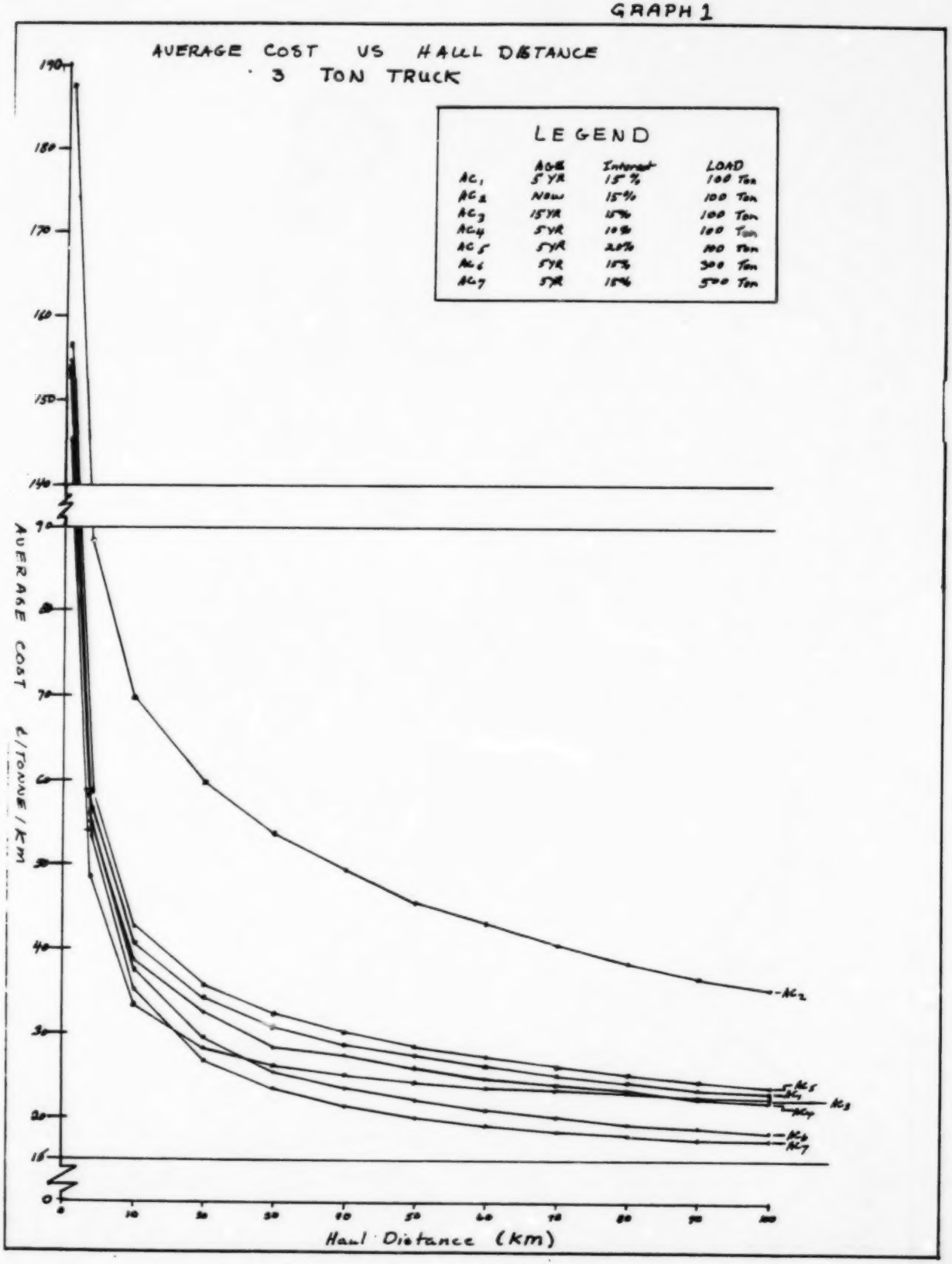
be owned by farmers and used for grain transportation.

Commercial-sized Vehicles: are trucks of 15, 25 and 40 ton size. These are the typical sizes for trucks which would be used by trucking companies in the hauling of grain.

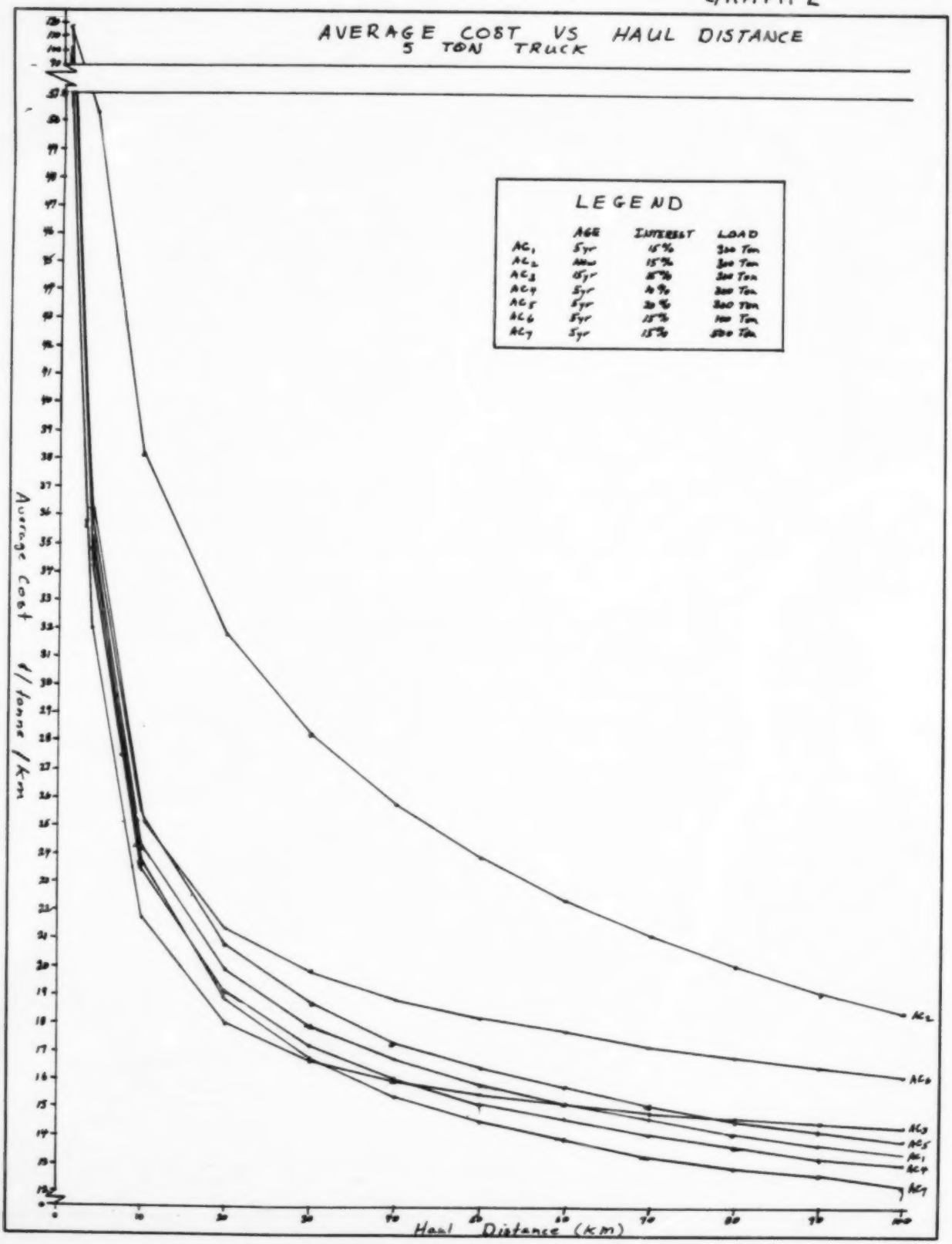
Grain Related Costs: are costs associated with the actual movement of grain from the farm gate to the elevator and the return trip.

Non-grain Related Costs: are costs incurred in operating the truck but incurred while not transporting grain from the farm gate to the elevator.

GRAPH 1

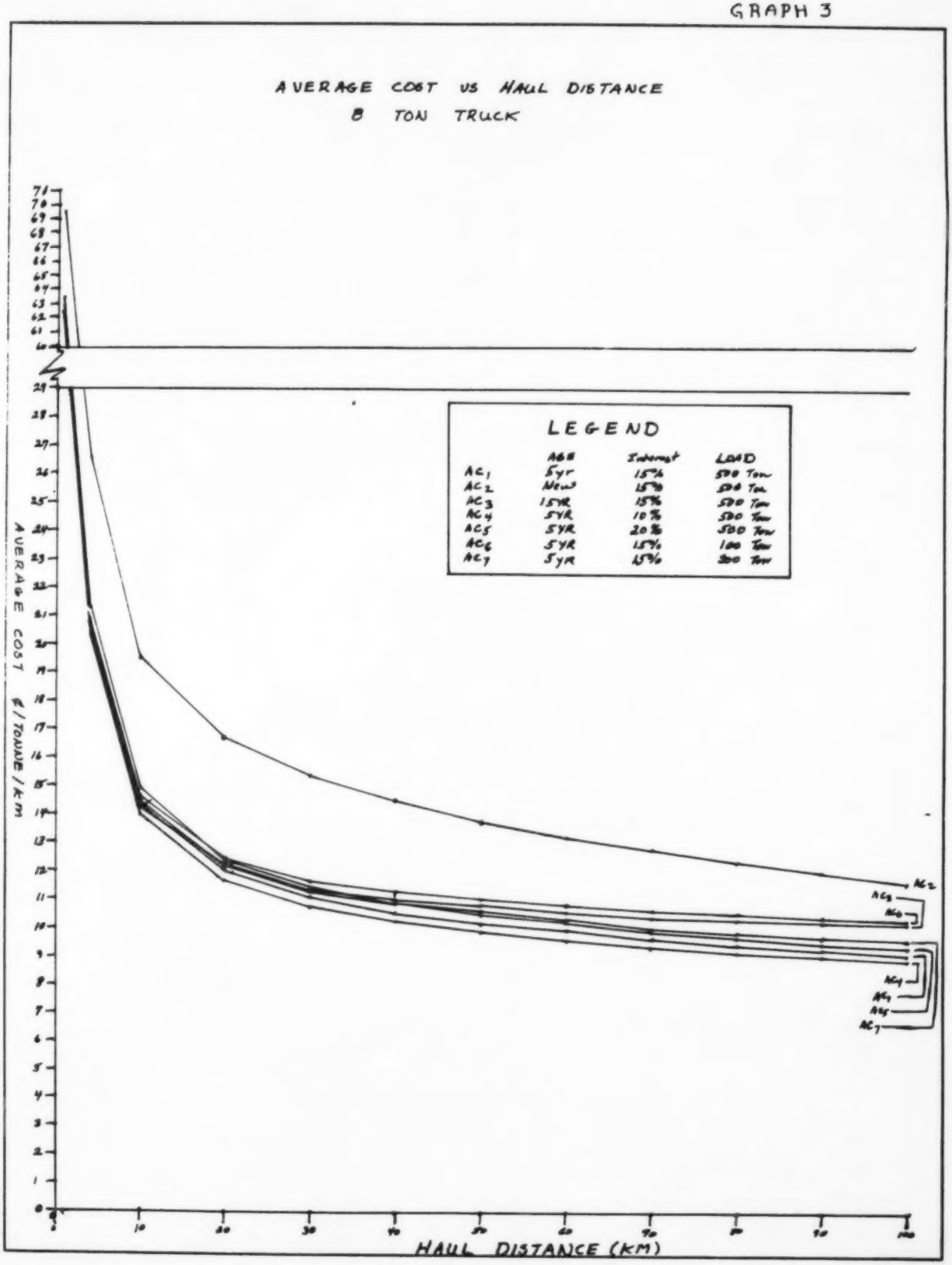

AVERAGE COST VS HAUL DISTANCE
3 TON TRUCK
LEGEND
AGE Interest LOAD
AC1 5 YR 15 % 100 Ton
AC2 New 15% 100 Ton
AC3 15 YR 15% 100 Ton
AC4 5 YR 10% 100 Ton
AC5 5 YR 20% 110 Ton
AC6 5 YR 15% 300 Ton
AC7 5 YR 15% 500 Ton
AVERAGE COST ¢/TONNE/KM
Haul Distance (KM)
AC2
AC5
AC1
AC3
AC4
AC6
AC7

GRAPH 2


AVERAGE COST VS HAUL DISTANCE
5 TON TRUCK
LEGEND
AGE INTEREST LOAD
AC1 5yr 15% 300 Ton
AC2 10yr 15% 300 Ton
AC3 15yr 15% 300 Ton
AC4 5yr 4% 300 Ton
AC5 5yr 20% 300 Ton
AC6 5yr 15% 100 Ton
AC7 5yr 15% 500 Ton
Average Cost $/tonne/km
Haul Distance (KM)
0
10
20
30
40
50
60
70
80
90
100
AC2
AC6
AC3
AC5
AC1
AC4
AC7

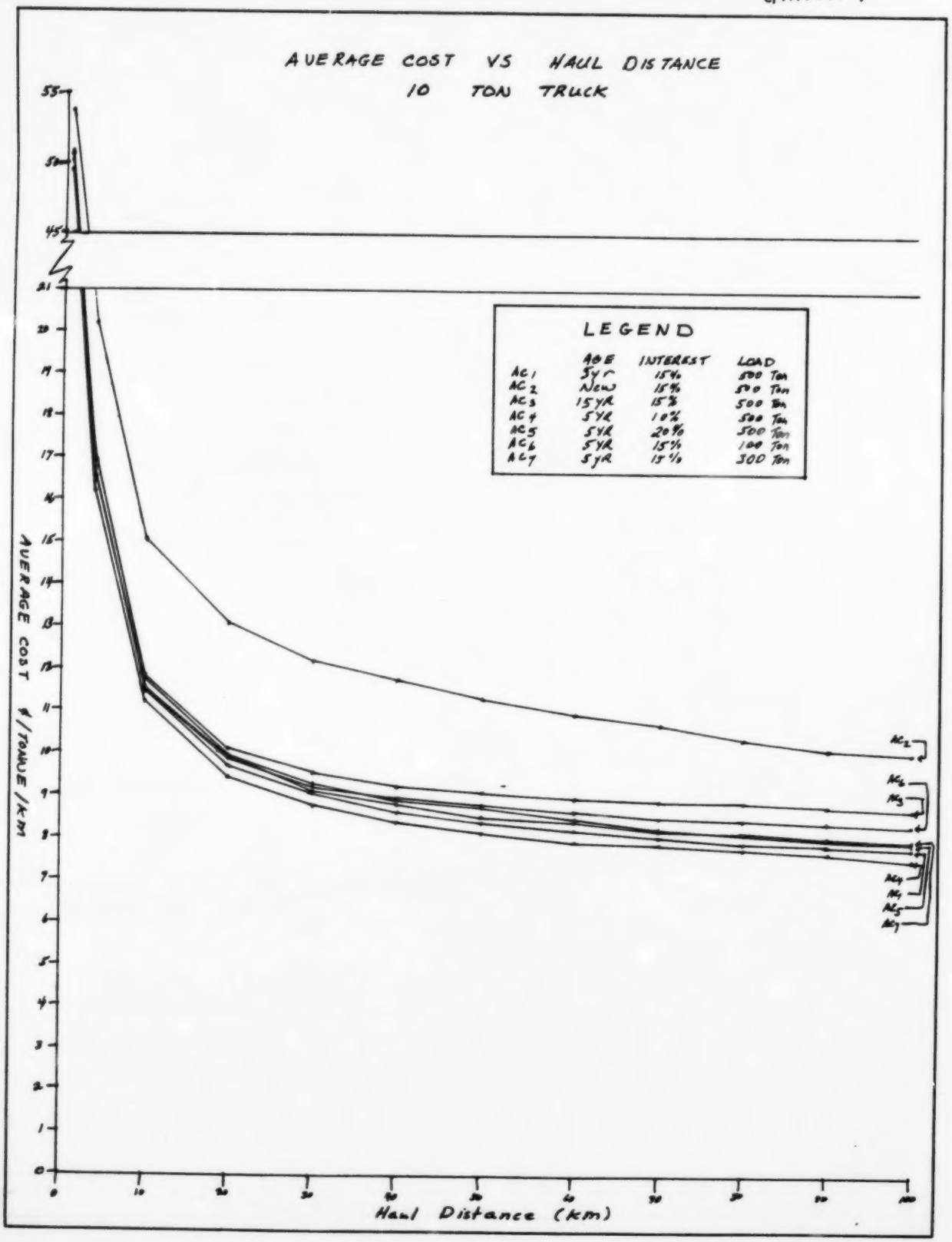
GRAPH 3

AVERAGE COST VS HAUL DISTANCE
8 TON TRUCK

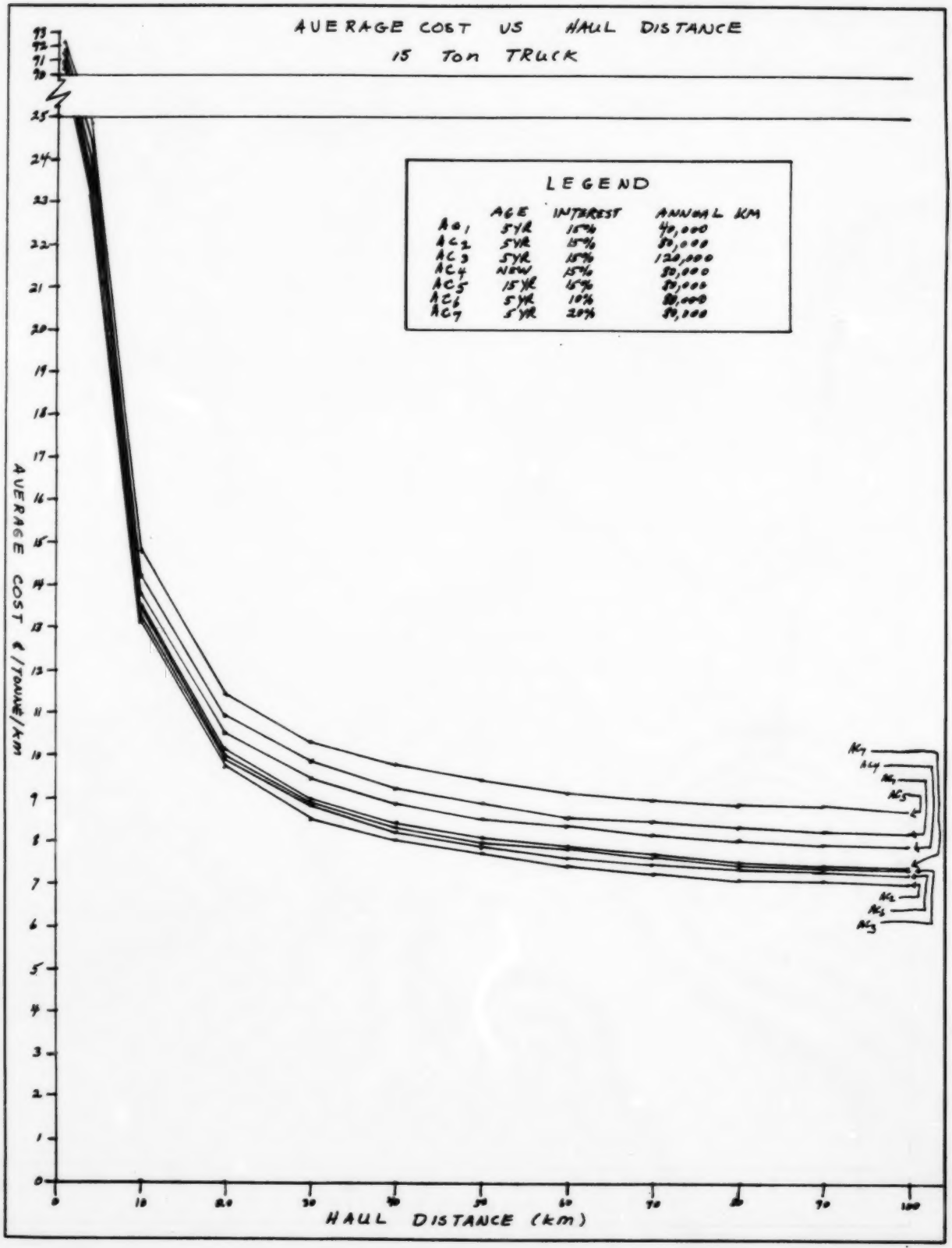

LEGEND
AGE Interest LOAD
AC1 5yr 15% 500 Tons
AC2 New 15% 500 Tons
AC3 15YR 15% 500 Tons
AC4 5YR 10% 500 Tons
AC5 5YR 20% 500 Tons
AC6 5YR 15% 100 Tons
AC7 5yr 15% 300 Tons
AVERAGE COST $/TONNE/KM
HAUL DISTANCE (KM)

GRAPH 4

AVERAGE COST VS HAUL DISTANCE
10 TON TRUCK

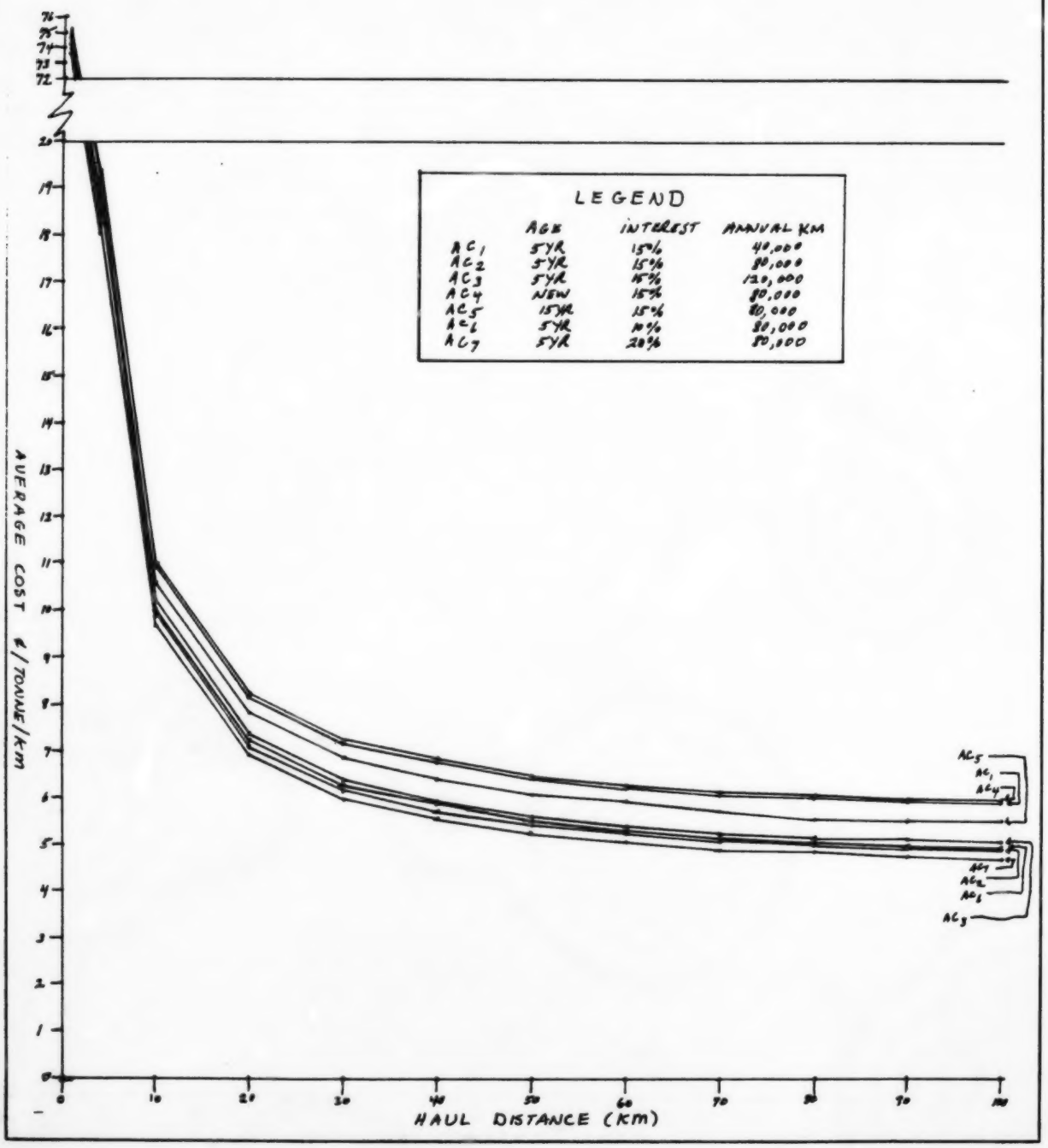

LEGEND
AGE INTEREST LOAD
AC1 5yr 15% 500 Ton
AC2 New 15% 500 Ton
AC3 15YR 15% 500 Ton
AC4 5YR 10% 500 Ton
AC5 5YR 20% 500 Ton
AC6 5YR 15% 100 Ton
AC7 5YR 15% 300 Ton
AVERAGE COST $/TONNE/KM
Haul Distance (km)

GRAPH 5


AVERAGE COST VS HAUL DISTANCE
15 Ton TRUCK
LEGEND
AGE INTEREST ANNUAL KM
AC1 5YR 15% 40,000
AC2 5YR 15% 80,000
AC3 5YR 15% 120,000
AC4 NEW 15% 80,000
AC5 15YR 15% 80,000
AC6 5YR 10% 80,000
AC7 5YR 20% 80,000
AVERAGE COST ¢/TONNE/km
HAUL DISTANCE (km)
0
10
20
30
40
50
60
70
80
90
100

GRAPH 6

AVERAGE COST VS HAUL DISTANCE
25 TON TRUCK



GRAPH 7

AVERAGE COST VS HAUL DISTANCE
40 TON TRUCK